

# Predicting Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa using NASA Earth Science Data for DoD - Global Emerging Infections Surveillance and Response System

## *Team:*

- *NASA-GSFC:* Jorge E. Pinzon (SSAI), Assaf Anyamba (GEST) ,  
Compton J. Tucker
- *USDA-CMAVE:* Kenneth J. Linthicum

## **Partners:**

### **Armed Forces Health Surveillance Center**

Kevin Russell, Clara Witt: Div GEIS Operations, Silver Spring, MD

### **World Health Organization**

Pierre Formenty

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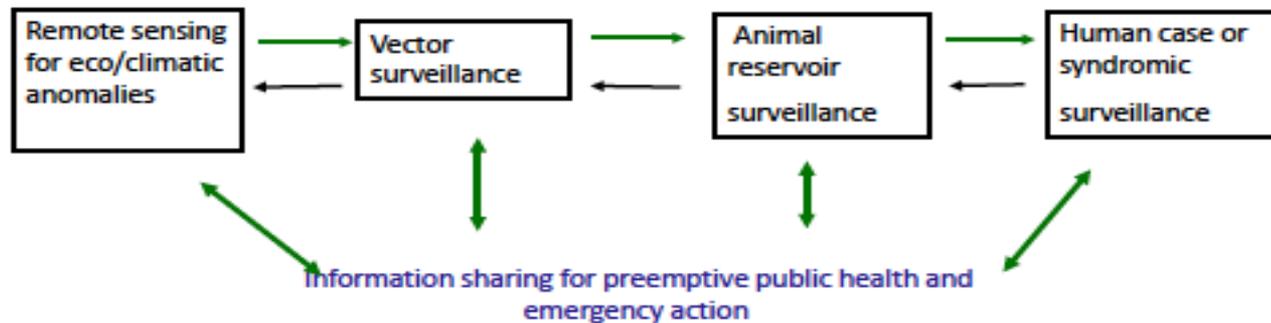
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# Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa

## Goals

- Strengthen DoD-GEIS efforts to build a sustainable global capacity for surveillance and response to emerging zoonoses with early warning capabilities developed from integrated NASA Earth science data and models that supports the AFHSC and promotes preparedness in US Forces, the Military Health System and the Global Public Health community.



- Refine the early warning models for Rift Valley Fever (RVF), and Marburg/Ebola Hemorrhagic Fever (MHF/EHF) filoviruses with multi-level monthly risk maps.
- Prototype the development and production of an environmental quality data record (NDVI-rainfall-temperature) that ensures consistency and continuity of data ingest to early warning models.



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# Global Public Health community – addressing delays in response

## Decision-Support Tool for Prevention and Control of Rift Valley Fever Epizootics in the Greater Horn of Africa

Consultative Group for RVF Decision Support\*

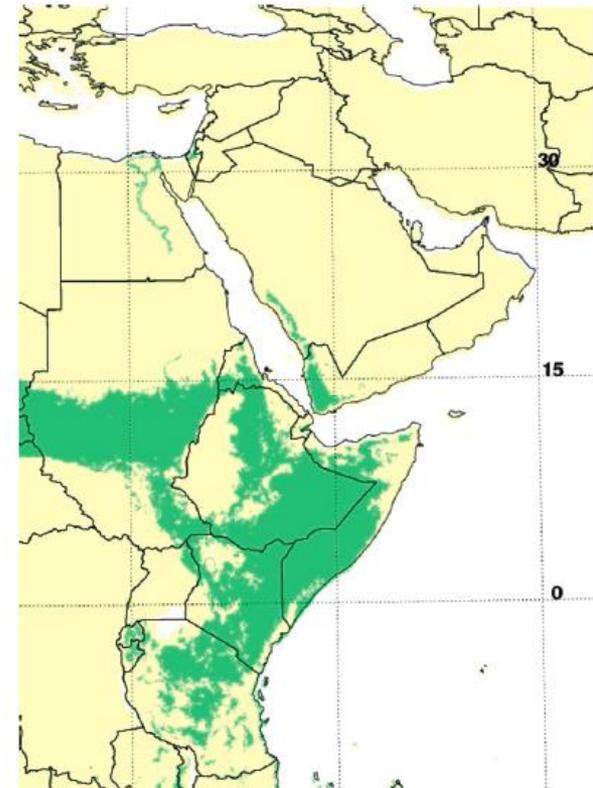
*Abstract:* In East Africa, Rift Valley fever (RVF) usually occurs as explosive epizootics with prolonged inter-epidemic periods on the order of 8 to 10 years. The episodic nature of the disease and the rapid evolution of outbreaks create special challenges for its mitigation and control. Following the events of the 2006 and 2007 RVF outbreak in East Africa, decision-makers assembled their collective experiences in the form of a risk-based decision support tool to help guide responses in future emergencies. The premise of the tool is that a series of natural events are indicative of the increasing

*Am. J. Trop. Med. Hyg.*, 83(Suppl 2), 2010, pp. 75–85

### **New Risk-based decision support tool**

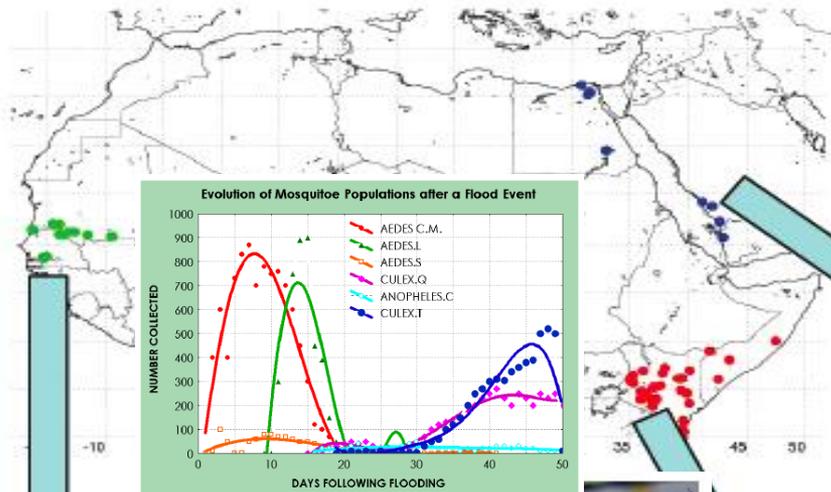
- The severity of the...RVF epidemic in northern Kenya was exacerbated by delays in recognizing risk factors.
- To address these issues and concerns, a joint Food and Agriculture Organization of the United Nations (FAO), the International Livestock Research Institute (ILRI) and the Government of Kenya Department of Veterinary Services (GoK DVS) assembled their collective experiences in the form of a risk-based decision support tool

**Element 1: RVF epizootic risk map.** This decision-support tool is intended for use primarily within areas of the Greater Horn that are at risk from epizootics of RVF. These are shown in green on Map 1 (Figure 1). Within these mapped zones are smaller areas of highest risk for early outbreaks that can be identified by departments of veterinary services based on known risk factors such as vector habitat, susceptibility to floods, soil types, dambos, and time of involvement in previous outbreaks.

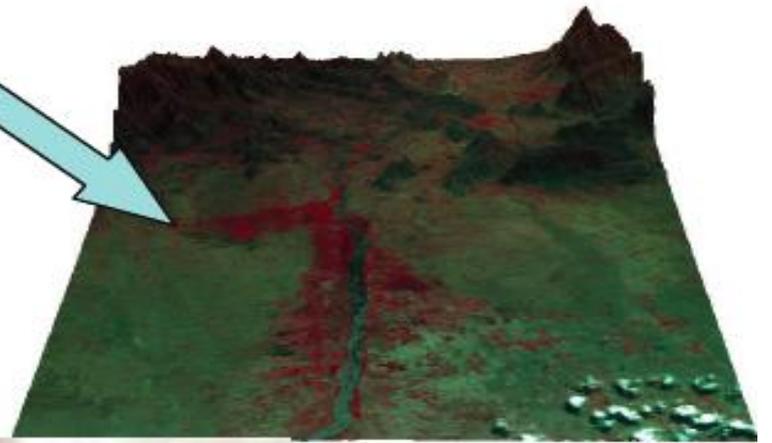


# RVF Modeling

Geographic Distribution of Recent Rift Valley Fever Outbreaks



Coastal Flood Plain



Riverine Flood Plain



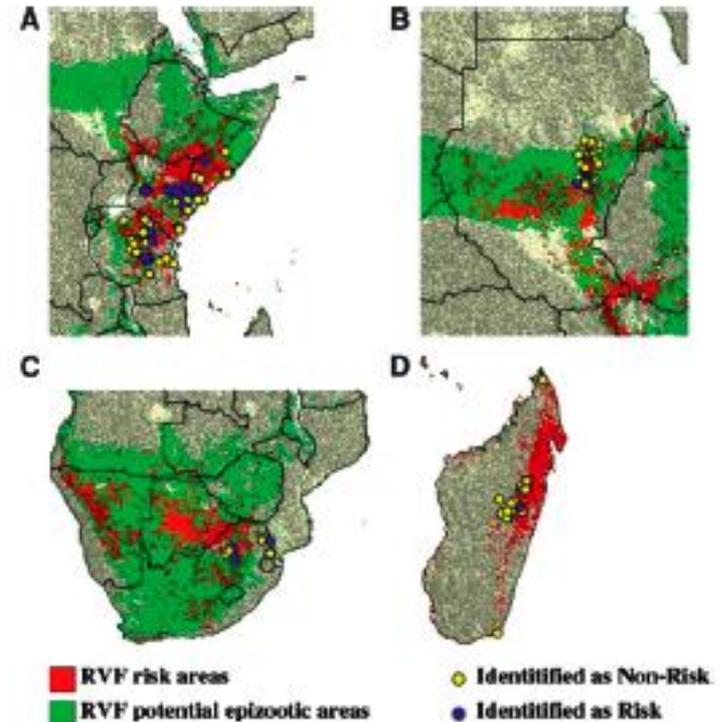
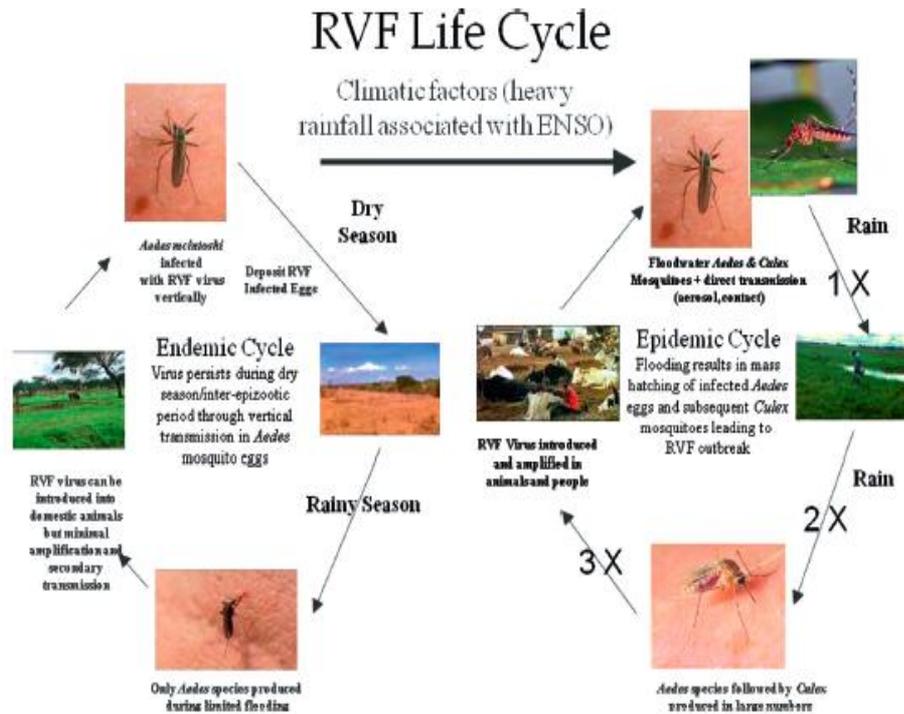
Savanna Grassland



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# RVF Monitoring



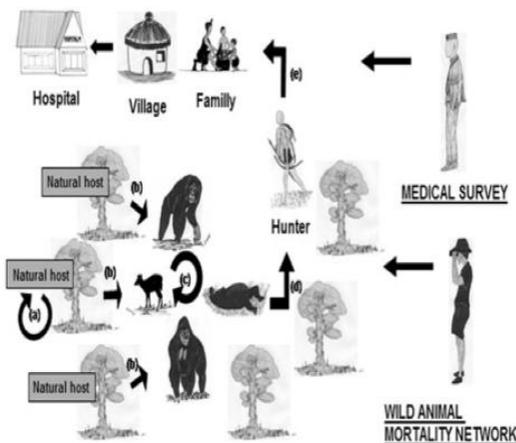
*Am. J. Trop. Med. Hyg.*, 83(Suppl 2), 2010, pp. 43–51



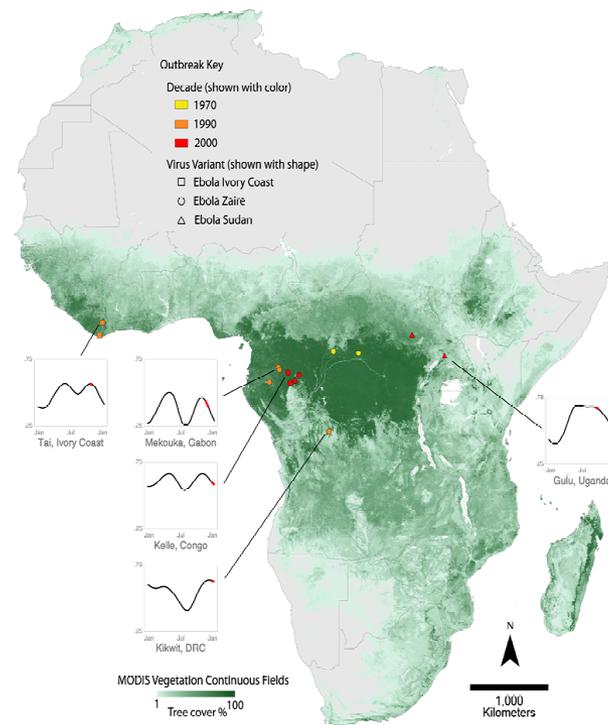
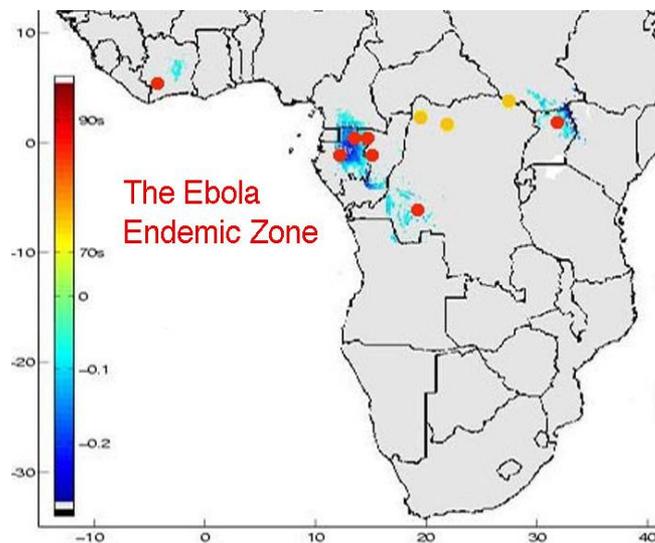
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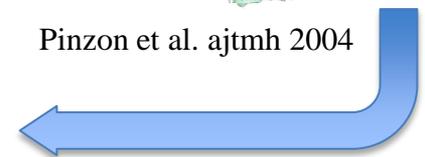
# EHF - Modeling



Ebola Cycle: Rouquet et al. EID 2005



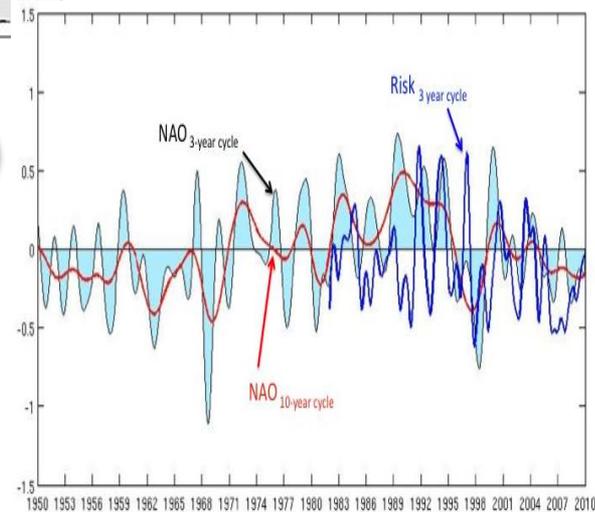
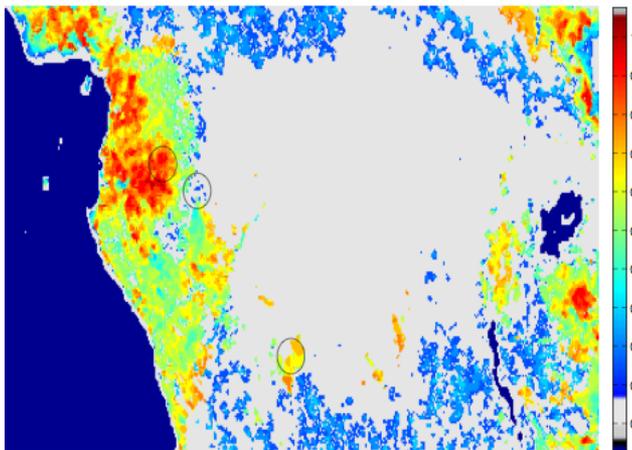
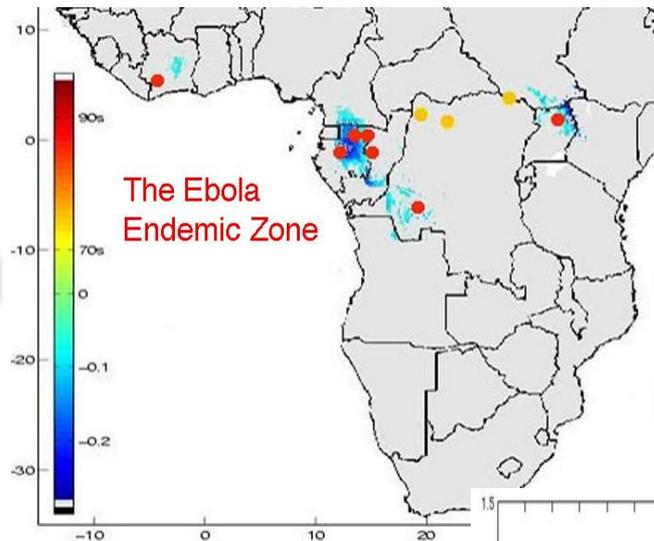
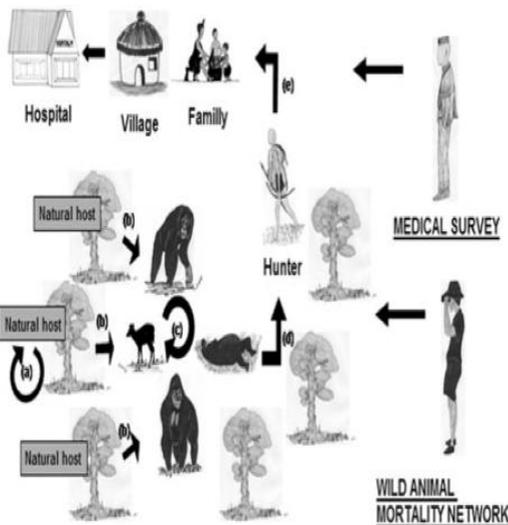
Pinzon et al. ajtmh 2004



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# EHF - Monitoring



UMBC

AN HONORS UNIVERSITY IN MARYLAND



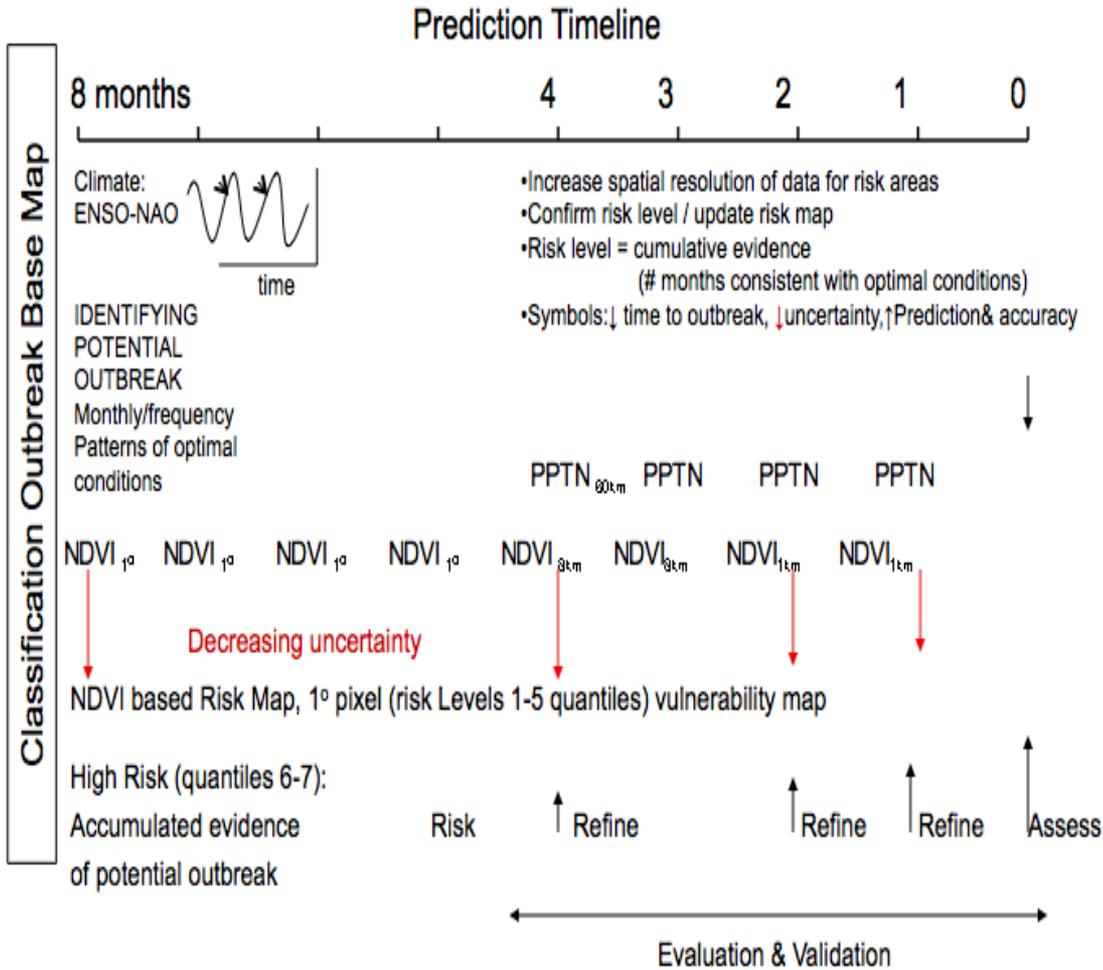
USDA



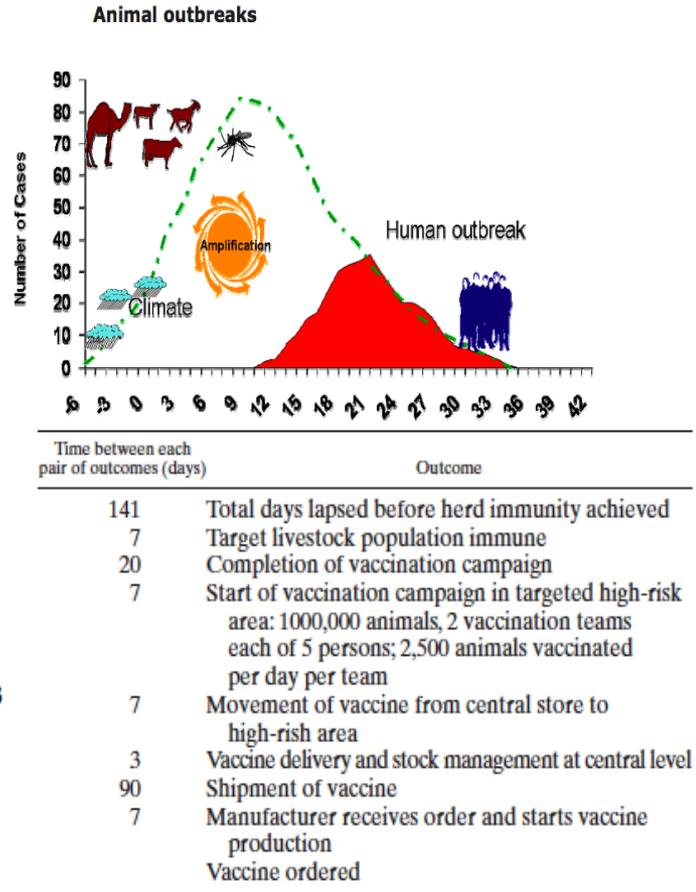
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# Prediction Framework



## Generation of a Human Outbreak

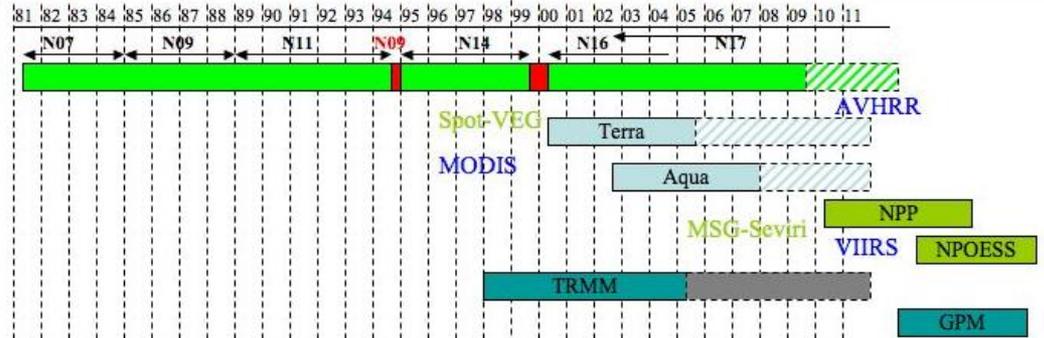
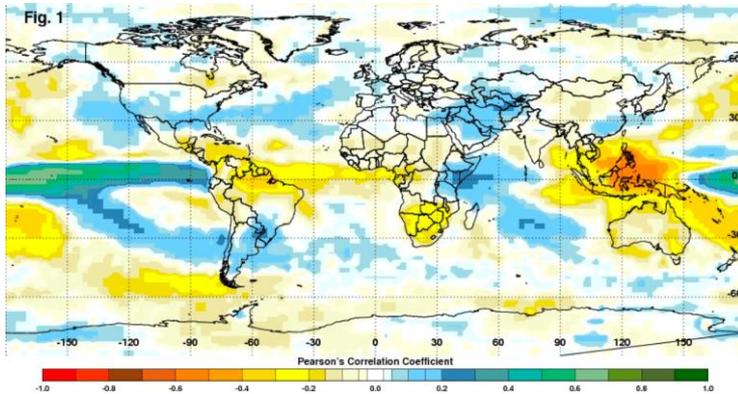


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# Model Inputs

## Correlation ENSO & Ecological Dynamics



### Inputs

### Current Sensor/Data

### Operating intermediate data

### Extended long-term monitoring

#### Climate time series

El Niño-Southern Oscillation(ENSO)  
North-Atlantic Oscillation (NAO)

#### Disease&Vector Data

#### Imagery time series

Precipitation (PPTN)  
Normalized Difference  
Vegetation Index (NDVI)  
NDVI / Temperature

Sea Surface Temperature (SST)  
From NOAA(monthly update)

Latitude&Longitude&Date

TRMM - monthly update  
AVHRR - biweekly or as  
needed  
MODIS - monthly

N/A

MeteoSat

SPOT  
MODIS

GPM / Jul 2013

NPP-VIIRS  
Jun 2011



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# More work needed- Year 3

**DoD - GEISWeb**  
Global Emerging Infections System

[MORE INFO >>](#) [About DoD-GEIS](#) [Global Networks](#) [Resources](#) [Featured Links](#) [HOME](#) [Search](#)

**Climate and Disease Connections: Rift Valley Fever Monitor**

[RVF Home](#) | [Background](#) | [Environment](#) | [Transmission](#) | [Climate](#) | [Monthly Updates](#) | [References](#)

**Locations**

- USAFSAM
- Egypt
- Indonesia
- Kenya
- NHRC
- Peru
- Thailand

**Programs**

- Antimicrobial Resistance
- DoD Laboratory Services
- West Nile Virus
- Gonococcal Surveillance
- Influenza
- Malaria
- Mortality
- Respiratory Disease
- Rift Valley Fever

**Meningococcal Disease Surveillance**

**IOM Review**

Monitoring and predicting disease outbreaks early enough to prevent them or reduce their impact on society is a major goal of the DoD's Global Emerging Infections System. A collaborative project between DoD-GEIS and NASA Goddard Space Flight Center accomplishes that goal, for at least for one disease: Rift valley fever. Using near-real-time satellite vegetation measurements and associated climate data sets including sea surface temperatures and satellite derived cloudiness indices predictions about emerging Rift Valley Fever epidemics in East Africa can be made several months before an outbreak occurs. Primarily a disease of sheep, cattle and other animals, RVF can be transmitted to humans by *Aedes* and *Culex* sp. mosquitoes. Outbreaks can be devastating to the farming economies of rural East Africa and can cause significant human morbidity and mortality. Outbreaks of RVF are now well known to be coupled with above normal rainfall in East Africa associated with warm SST warming events in the Western Equatorial Indian Ocean and El Niño events in the Pacific. Monitoring the state of sea surface temperatures, rainfall and ecological conditions guides the efforts in identifying areas of potential RVF outbreaks. The ability to map such areas of potential RVF activity 2 to 5 months before outbreaks occur could permit vaccination of domestic animals and implementation of appropriate mosquito control programs.

DoD-GEIS & NASA/GSFC are now making current satellite of on areas at risk to RVF outbreaks available on this web continuing effort in disease monitoring and surveillance. contained in this report has significant potential implications for disease prevention and control, we do not suggest that this information is absolute with regard to actual disease occurrence nor can it be used as the only basis for public policy on this disease. Rather, it is intended as a vehicle for identifying areas where field surveillance and validation of can be carried out. Persons with information that can help corroborate or refine the information contained in these pages are urged to contact us at the address indicated below. In addition, all constructive comments related to the presentation of these materials are welcome. Given this intent, persons who use this information do so at their own risk. Neither the DoD-GEIS nor NASA/GSFC take any responsibility for the consequences of any actions based on this information. All users are therefore cautioned to treat this information in the manner intended -- as a statement of research in progress for the purpose of scientific validation and review.

Updates will be posted to the DoD-GEIS web site on a regular basis.

**Zoonotic Viral Hemorrhagic Fever**

Home

You are here: Rift Valley Fever » RVF Risk Maps

**CURRENT RISK MAPS FOR RIFT VALLEY FEVER**

RVF Potential November 2009

RVF risk areas, humans and livestock present

RVF risk areas, humans and livestock absent

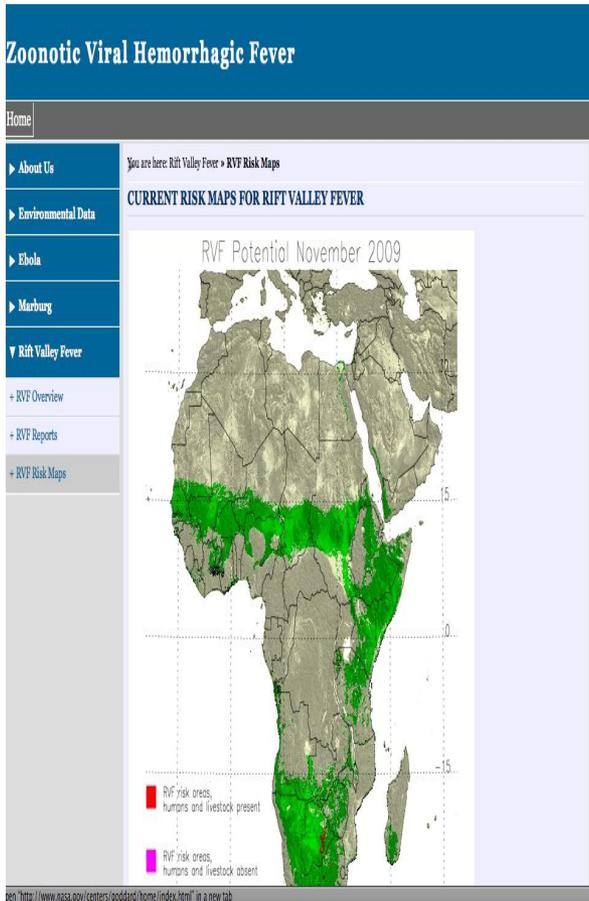
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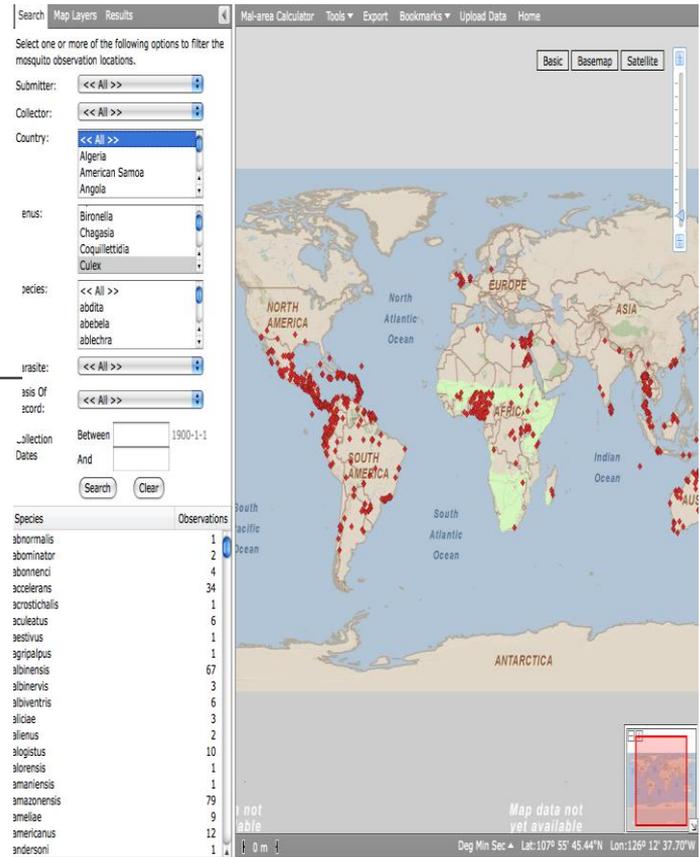
# More work needed- Year 3



DEED

Hard!	Top Gun
Winging it	No problem

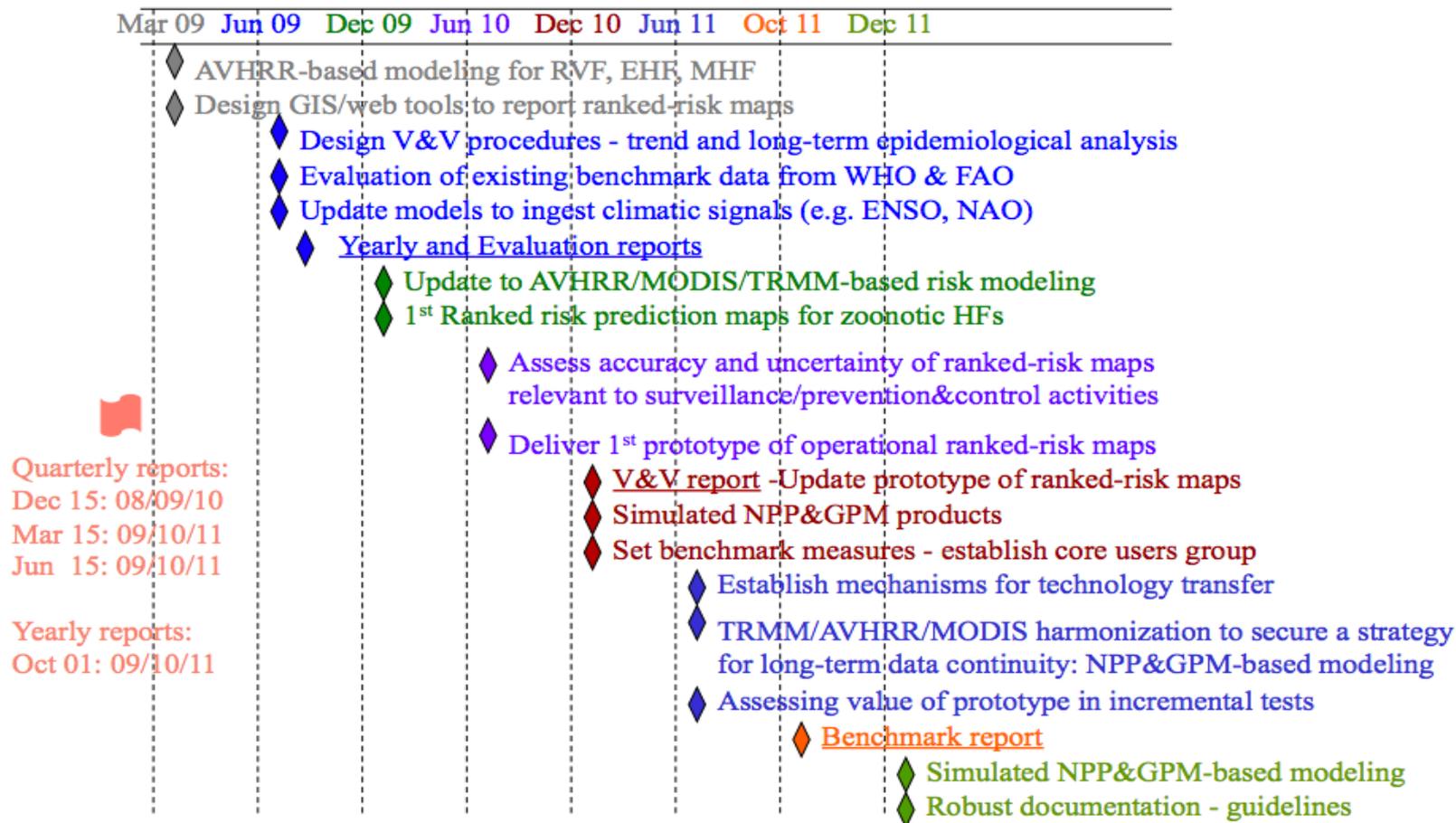
Broad  
+



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# Zoonotic HFVs milestones



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## **Contributors**

- Jorge Pinzon, Assaf Anyamba, Jennifer Small, Compton J. Tucker & Ed Pak: NASA/Goddard Space Flight Center, Biospheric Sciences Branch, Code 614.4, GIMMS Group, Greenbelt, Maryland.
- Kenneth J. Linthicum & Seth Britch: Center for Medical, Agricultural & Veterinary Entomology, Agricultural Research Service, United States Department of Agriculture, Gainesville, Florida.
- Kevin Rusell, Clair Witt: Armed Forces Health Surveillance Center/Div GEIS Operations, Silver Spring, MD
- NOAA Climate Prediction Center, Camp Springs, Maryland.
- USDA Foreign Agricultural Service (FAS), Washington D.C.

## **Field Surveillance & Data Support**

- Jason Richardson, David Schnabel & USMARU/GEIS-K Entomological Team
- Rosemary Sang & KEMRI Field Team
- Robert Breiman, Allan Hightower CDC Team –Kenya
- Pierre Formenty, WHO
- Stephan De La Rocque, FAO
- Bob Swanepoel, NCID, South Africa

Thank you! Questions?

[jorge.e.pinzon@nasa.gov](mailto:jorge.e.pinzon@nasa.gov)

301-6146685